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Dead groups that are alive and live groups that are dead

by François Lorrain¹

SUMMARY.

It is extremely rare that players disagree as to which groups are alive and which are dead, at the end of the game. The concepts of life and death seem straightforward and without mystery. A close examination of these concepts, however, produces many surprises. Life and death are far more difficult to define than one would have thought.

In the usual formulations of the rules of go, the scoring is defined in terms of live and dead groups. A recurring flaw in these formulations is that they give a definition of life and death that is too simple, and therefore erroneous. At first sight, this flaw seems very difficult to correct. The Chinese rules of go are the key to a satisfactory—and simple—solution to this difficulty. This solution may be of help in teaching go to beginners.

Many readers are already familiar with the Chinese rules of go. For the benefit of those who are not, I start with a short description of these rules.

The Chinese rules of go

The Chinese count as territory *live stones and surrounded points*. They do not take prisoners into account. At first sight, this way of counting seems very different from the Japanese (more exactly, the Korean-Japanese) counting which most Western players use. It turns out, however, that the *results* of these two counting methods (the resulting *territorial differences*) are often the same and, when not, they usually differ by only one point. How is that?

Imagine an ordinary game, without handicap stones or compensation points. Suppose *White plays the last stone and no player has passed until then*. Then both players have played exactly the same number of stones. Place all dead stones and prisoners in territories of their colour. There are now equal numbers of black and white stones on the board. Obviously the same territorial difference will result, whether one counts as territory only vacant points, or stones plus vacant points.

Suppose now that *Black* has played the last stone, and no player has passed until then. Black has played exactly one more stone than White. After prisoners and dead stones have been filled in, the number of black stones on the board is equal to the number of white stones plus one. The Chinese result is one point higher, in favour of Black, than the Japanese result.

The numbers of Black and White stones played can also differ due to passes that occurred before the last stone was played. This rarely happens, but this can also lead to a difference between the results of both counting methods.

The Chinese and Japanese rules also differ in the way they treat *seki*. The Japanese do not count as territory vacant points surrounded by groups that are alive in *seki*. The Chinese count as territory *all* live stones and the points they surround.

Sekis with surrounded points are rare. So are passes before the last stone. Chinese go is therefore essentially the same game as Japanese go.

But the Chinese rules have one crucial advantage: they make it easy to settle disagreements about life and death at the end of the game. For example, Black claims that a certain white group is dead, but White disagrees. White insists that Black must actually capture the group, in order to prove that it is dead. With the Chinese rules, Black will readily agree to do so: the stones he plays inside what he considers to be his own territory do not affect its size. With the Japanese rules, however, in order to capture, Black might have to play more stones than White will play, and this will affect the score. A complex set of special rules must be added to the Japanese rules to deal with such disagreements. With the Chinese rules, no such special rules are needed: in case of doubt, just play it out!

With the Japanese rules, disagreements can also occur as to whether certain reinforcement plays (settling a *kō*, for example) are necessary or not; a difference of one or more points might be involved; again special rules are necessary to deal with such cases. With the Chinese rules, special rules of this kind are unnecessary; the same motto always applies: when in doubt, play it out.

In 1978 the New Zealand Go Society, in 1991 the American Go Association, and more recently the Fédération française de go,² adopted official rules of the Chinese type (they differ in points of detail). These associations have done this essentially because of the simple “play it out” feature of the Chinese rules. Even complete beginners can understand and apply this feature easily; this is a major motivation, because in the West high level players are not everywhere available to interpret the rules. The new AGA rules describe a counting method that is almost identical with traditional Japanese counting,³ but results in the same territorial difference, in all cases, as Chinese counting. Players used to Japanese counting can adopt the new rules with ease. Other national associations are seriously considering the adoption of similar official rules.

The “play it out” feature also makes it simpler to discuss life and death. Because of this, my analysis of these concepts will be based on the Chinese rules. From now on, I shall always count territory in the Chinese fashion: live stones plus surrounded points (prisoners being entirely disregarded).

The intricacies of life and death

The goal of the game is to obtain a larger total territory than one's opponent. Territory is usually defined as follows.

A **black territory** is an area delimited by a *live* black group, such that (a) all white stones in this area are *dead* and (b) any white stone that would later be played in this area would become *dead* as soon as it touches the board. A **white territory** is defined similarly.

How are *live* and *dead* defined? The usual definitions are as follows. In these definitions, the word *eternity* designates any repetitive situation (such as a $k\bar{o}$, double $k\bar{o}$, triple $k\bar{o}$, or any other kind of repetitive situation)⁴ and the phrase *eternity rule* designates whatever rule has been agreed to apply in such situations.⁵

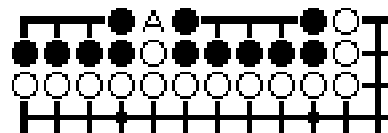
We shall say that a group is **alive (in the narrow sense)** in a given state of the game, if the following condition is satisfied. If the eternity rule is obeyed and if the advantage of the first move belongs (or is passed) to the opponent, then, *whatever the moves played by the latter*, the group's side *can* (if it wants to) reply in such fashion that the enemy will never be able to capture a single stone of the group.

We shall say that a group is **dead (in the narrow sense)** in a given state of the game, if the following condition is satisfied. If the eternity rule is obeyed and if the advantage of the first move belongs (or is passed) to the group's side, then, *whatever the moves played by the latter*, the enemy *can* (if he wants to) reply so as to capture the whole group.

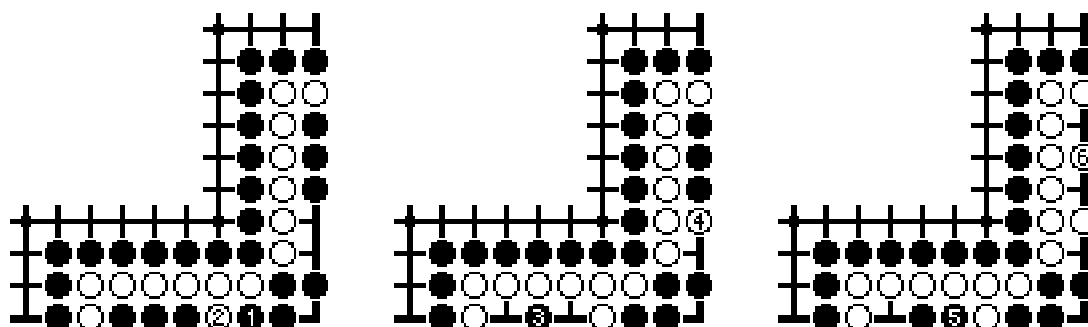
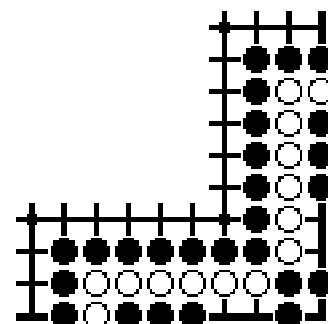
I have written these definitions very carefully, spelling out what is usually left unsaid. Okay. What's the problem?

First of all, here are examples that show that these notions are more subtle than appears at first sight.

1. Each one of these two black groups is alive in the narrow sense, but the union of the two groups (the large black group of twelve stones) is not alive in the narrow sense: if White plays at A, he can capture part of it. So what? Well, consider the next example.

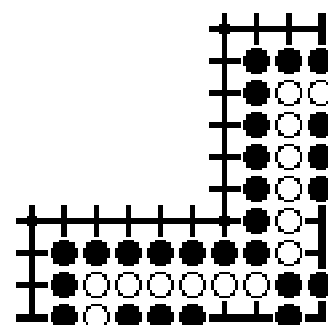


2. Each one of the two white groups is *dead in the narrow sense*, but *the union of these two groups is not dead in the narrow sense*. This is one of the cases considered in the Japanese rules of go. If White plays first, Black can capture all the white stones. However, if Black plays first, at ①, he can capture the white group on the left, provided he lets the other white group live in the narrow sense.



These examples are instructive. They show that, instead of speaking of several black and white territories, we must speak of a single large black territory and a single large white one. The large black group delimiting this large black territory is the union of all the small black groups delimiting the small black territories. This large black group must be alive, and the large white group that combines all the white stones in the area claimed by Black must be dead. This way of defining territories, though a bit abstruse, may seem satisfactory. It contains a portion of truth, but we shall see that it is incomplete. If this direction is followed, infinite complications result.

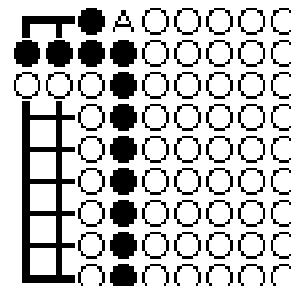
3. In the same situation as above, the two black groups of three stones are *alive*, not in the strict narrow sense, of course, but *in a slightly wider sense*: White can capture either one of them, or both, but Black can then capture all the White stones and recreate his lost groups. *The union of the two black groups is also alive* in the same sense. Obviously White will avoid playing first in this situation. However, if Black wants to keep both his groups alive, he must abstain from playing at all in this region



and let the two white groups live, in a kind of *seki*. Now this gives Black 10 points and White 14 points, while the sequence above, in which Black sacrifices his right side group, gives Black 16 points and White only 12. Therefore, though the union of the two black groups is alive (in the slightly wider sense described), in fact the group on the right is *dead (in an even wider sense)*, since it is captured in the above sequence. As to the black group on the left, it is also captured in this sequence, but, since it can be reconstituted afterwards (with ③, ⑤ and a last move capturing the white group on the left), it is *alive in the wider sense*.

Complications are indeed arising! Here is a simpler example that also shows the limitations of our concepts.

4. The big white group is *dead in the narrow sense*, but, in a way, it is *also “partially alive”*. If Black captures it, White will play the first move in the newly vacated space and will establish there a group that is alive in the narrow sense. (Note that, if the finality of the game is taken into account, Black is forced to play at A. Indeed White will demand that Black capture effectively; if Black passes instead, the white group becomes alive in *seki* and Black loses 14 to 66. If, however, Black plays at A, he will probably win by a few points.) This example is admittedly artificial, but it is significant.



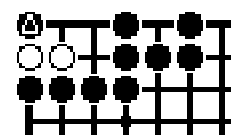
Note that in examples 1 and 2 the *finality of the game*—maximising the difference between my total surface and my opponent’s—plays no role. It does play a role, however, in example 3. In example 4 it does not really play a role.

Note also that, in these four examples, the game is still unfinished, in the sense that the final territorial boundaries are not completely staked, yet. In all the examples that follow, however, the final territorial boundaries will already be marked out on the board.

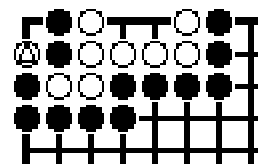
The notions of life and death in the narrow sense are certainly essential to the practice of go. Our examples show that these notions are not completely adequate, however, and that concepts of life and death “in the wider sense” must also be defined. But let us leave until later the exact definition of the latter concepts; it will be instructive first to examine a few other examples, which will help us get a better feeling of what is involved.

First two very common examples, in which the game can be considered finished.

5. *Black stone that is dead in the narrow sense, inside a black territory.* However, one could also say that it is *alive in the wider sense*.



6. *White stone that is not alive-in-the-narrow-sense, on the periphery of a white territory.* One could say that this stone also is *alive in the wider sense*.



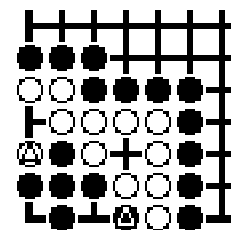
In the foregoing examples there are no eternities and, in all these examples, except one, the finality of the game is irrelevant. In all the following examples, there will be *eternities*, and the *finality* of the game will play a role.

The eternity rule that we shall use, in these examples, will be the simplest one of all, the so-called “super-kō” rule:

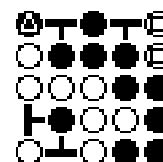
Super-kō rule. It is forbidden to make a move that results in a whole-board position that is identical with a previous whole-board position,⁶ unless this move is a pass (or a one-stone suicide⁷).

The usual kō rule follows from this more general and precise rule.

7. *Double kō.* At the end of the game, the two stones in atari are *dead in the narrow sense* (if capturing each of them is permitted), but they are *alive in the wider sense*: it is not profitable to capture them.



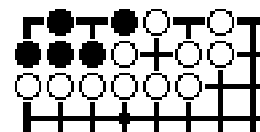
8. *Seki with kō* Black has just captured a stone by playing . White can only pass. The group of two stones is *dead in the narrow sense*, but, if Black captures it, White will play on one of the two vacated points and Black will end up losing everything. If Black plays in the bottom left, White will take and once more Black will finally lose everything. Therefore Black too must pass and the game is finished.⁸ All the stones on the board are *alive in the wider sense*, in a kind of seki, and Black wins 12 to 10.⁹



In the last two examples, as in the others that will follow, there are kōs. In the first one, there was no need to calculate kō threats. In the second one, the kō threats threaten either global takeover or nothing. However, in the examples below, computation of the possible consequences of threats (in attack as well as in defense) is crucial; in these examples, therefore, the finality of the game will play a more complex role than was the case up to now. These further examples of dead groups that are alive, and of live groups that are dead, occur in two classical situations: moonshine life and bent four in the corner.

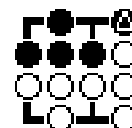
Moonshine life

9. A group in moonshine life, as the black group shown here, is almost always *dead in the narrow sense*. If White wants to capture it, he can do so, and Black will be unable to hinder him —except in very rare situations, as in example 10. Moreover this black group is almost always also *dead in the wider sense*. Indeed, to defend his group, Black must play real kō threats, while White can use *almost any* move as a kō threat—even moves that do not force an answer from Black. In most circumstances, Black will use up all his threats before White does his, and the Black group will inevitably be captured.



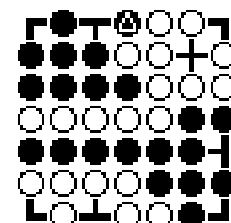
10. Here is an exception: a group in moonshine life that is *alive in the narrow sense*.

Black has just captured a stone by playing ⑤. Both groups are alive in the narrow and wider senses. Black loses 7 to 9, not 0 to 16.

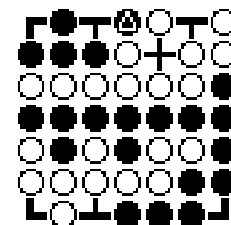


In the next example, White can capture, but only by paying a price.

11. The white group at the bottom is *alive in the narrow sense*, it is even *uncapturable*, but we shall see that *White must sacrifice it* to win the *kō* fight. Black has just captured a stone by playing ⑤. If White does not reply, he loses 24 to 25. If White sacrifices his lower group (by filling in one of its eyes as a *kō* threat), he wins 26 to 23. The lower white group is therefore *dead in the wider sense*! A live group, in the narrow sense, even a strictly uncapturable one, is not necessarily alive forever; unexpected exchanges sometimes happen.



12. The upper black group is *dead in the narrow sense*, *alive in the wider sense*. Black has just captured a stone by playing ⑤. White can play a threat in the lower left. Black will respond (otherwise he loses everything). Then White will capture the upper black group and lose 20 to 29. If White had let this black group live, the outcome would have been a draw: 24 to 24.



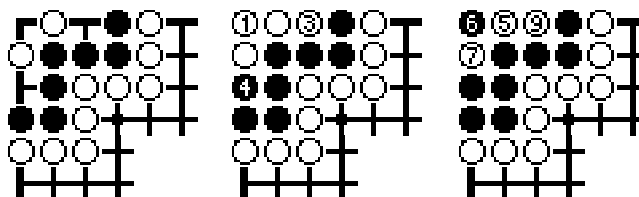
Bent four in the corner

13. This black group is *always dead in the narrow sense*.

② elsewhere or pass,

⑧ elsewhere or pass.

It is also usually *dead in the*

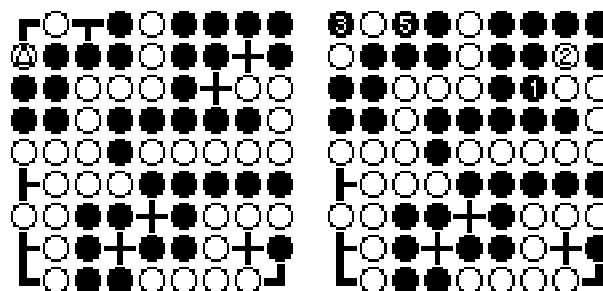


wider sense, because, before playing ① etc., White will in most cases be able to wait till all other territories are completely delimited and take the time to eliminate one after the other the *kō* threats that could be used against him. However, there are certain kinds of threat that White can eliminate only at the cost of losing at least as much as he would lose by not answering the threat: for instance, the threats inherent to sekis. In such cases, the life or death of the black group depend on what one and the other side risk losing, if Black uses the threat. The example below is such a situation.

14. *Dead in the narrow sense; alive in the sense that Black can play in such a way that it will be in White's interest to let it live; but dead in the wider sense.* White has just captured a stone by playing ㉔.

If Black lets White capture his group, he wins 40 to 39.

However, if Black plays the threat ㉕, White will respond (otherwise he loses 31 to 50), White will pass with ㉖ (he can do no better) and then Black will make his group uncapturable with ㉗. Outcome: Black loses 38 to 43. He would have done better to let go of his group in the upper left.



An end to bewilderment

Life and death are very relative concepts. The last example is particularly striking in this regard. How can the rules define which groups are truly alive and which are truly dead, at the end of the game? Such a definition is necessary; without it, the counting of points—and therefore the very goal of the game—cannot be defined! But at the same time “true” life and death are so bewilderingly complex, that a definition seems quite out of the question.

It is true that most of the situations on which I base this conclusion are extremely rare. Nevertheless, complete and rigorous rules must cover all possible situations, however infrequent.

It turns out that there is a simple way out of our difficulty. The key is the “play it out” feature inherent to the Chinese rules that we have been using all along. If there is any doubt as to whether a given group is “truly” dead or alive, one finds out by continuing to play. The group is alive if it stays on the board, it is dead if it is captured. If the players make mistakes while continuing to play in this fashion, too bad! The only criterion of true death (of death in the wider sense) is actual capture. Correlatively, the only criterion of true life (of life in the wider sense) is non-capture!

|| A go game is *truly* ended only when all territories are free of enemy stones.

Fine, but what is a territory?

|| A *true* territory is just an area that is delimited by a group and contains no stone of the opposite colour.

Now, wait a minute! Is go as simple as that? Should we not add that the group delimiting the territory must be “alive”? No, this is unnecessary. “Alive” just means “still on the board

at the end". Any area that is delimited by a group and contains no stone of the opposite colour is a *territory*. These absurdly simple definitions are enough. The catch, of course, and the source of all complexity, is that each player endeavours to maximise the difference between his total *territory* and the other's, while bearing in mind and using the capture and eternity rules. This is where go becomes go. And this is where the notions of life and death in the narrow sense, in the wider sense, and in other intermediate senses as well, come in useful. The game continues until each player is satisfied that there is nothing he can do to change the balance of *territories* in his favour.

Of course, in practice, players will usually stop playing before the true end of the game. If, at any time during the game, they agree that the boundaries of the final territories are completely marked out, and if they have the same perception of what the final territories would be, it is useless for them to continue playing. They agree that further play would change nothing to the boundaries and would only consist in routinely capturing stones that both agree would finally be captured. The players may immediately rearrange the board and count the points.

One must clearly distinguish between the *true end* of the game and its *end by agreement*. I like to call these two ends the **formal end** and the **practical end**.

At the practical end of the game, the stones that are alive are not necessarily those that *cannot* be captured; they are those that *would not* be captured, that is, those that would still be on the board *at the formal end*. Similarly, at the practical end, the dead stones are not necessarily those that *can* be captured; they are those that *would* be captured, that is, those that would no longer be on the board *at the formal end*.

Most existing sets of rules do not clearly define and distinguish the formal and practical ends. And the practical end can only be defined by reference to the formal end. One should not try to define the practical end *per se*, and then add rules governing the *continuation* of the game in case of *disagreement*. The REVERSE must be done: one must define a longer formal game, and then add rules governing the *shortening* of the game in case of *agreement*!¹⁰

One cannot—in a simple and lucid fashion, at least—base the concept of territory on those of life and death. The REVERSE must be done: one must define the concept of territory and the goal of the game without any recourse to the notions of life and death — as I have done above,— and then use these definitions to define “true” life and death.

It is interesting to note that the theoretical reversals and simplifications just described are largely based on the analysis of unusual cases, just as in science new theories often arise from a study of seemingly marginal phenomena. A nice feature of rules formulated in such reverse fashion, however, is that they need not mention a single one of those rare or unnatural situations. All such situations are *implicitly* covered by rules of this kind.

The notion of true, formal territory, and the notion of the true, formal end of the game, are not new. They have appeared, under other names, in a number of publications over the years. The fundamental significance of these notions, however, is rarely recognised. In the West, the mark of the traditional Japanese rules is very deep. We are most grateful to Japan for having taught us and continuing to teach us go. Unfortunately, the Japanese rules try to define only *one* end of the game, the practical end, with territories defined in terms of live and dead groups. As we have seen, this can be a source of infinite complications, even for experienced players; it is also a stumbling block for beginners. Interestingly, one of the few authors who has emphasised these theoretical issues, and proposed similar solutions, is a Japanese! Ikeda Toshio, an electronics engineer, described as “one of the main figures in the development of Japan’s computer industry”, and go

aficionado, wrote a number of articles on the subject, which were recently translated and collected in a book, *On the rules of go*.¹¹

I have written an introduction to go for beginners, entitled *Le go, le grand jeu de l'Orient* (forthcoming), that uses Chinese rules, divided in two subsets: a set of “formal rules” (based on the notions mentioned) and a set of “practical rules” (governing the early ending of the game by agreement). Hopefully beginners—especially young children—might find it easier to start playing go using the formal rules only, on a small board; after they have gained some understanding of life and death in actual formal games, they would easily learn to shorten the game with the practical rules.

May 1997.

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- 1 The author teaches mathematics at Collège Jean-de-Brébeuf in Montréal (Québec).
 - 2 For the New Zealand rules, see James DAVIES, “The rules of go”, in *The Go Player's Almanac* (ed. by Richard BOZULICH), Tōkyō, Ishi Press, [©1992], pp. 246 f. Or see <http://www.es.co.nz/~barryp/>.
For the AGA rules, see the above, pp. 251 ff., or <http://www.usgo.org/org/index.html>.
For the French rules, see <http://www710.univ-lyon1.fr/~ffg/REGLES/regle.html>.
 - 3 The only differences are the following: (a) each time a player passes, he gives one of his stones to his opponent as a prisoner, (b) the last pass of the game must be made by White (the game might end with three passes instead of two). This ensures that both players have “played” exactly the same number of stones. After filling in dead stones and prisoners, the numbers of black and white stones on the board are equal. The territorial difference is the same, whether one counts only vacant points, or stones plus surrounded points.
 - 4 The word *eternity* is a reasonable equivalent of the Japanese word *kō*, which is a Buddhist term (the Sanskrit word is *kalpa*) for “an enormous passage of time, the next thing to eternity”.
 - 5 Eternity rules vary a lot. At one extreme, one finds the lengthy Korean and Japanese eternity rules, which are almost equivalent. At the other extreme, there is the so-called “super-*kō*” rule, which simply forbids the repetition of any previous full-board position; this rule has been adopted in continental China, New Zealand, the U. S. A., and France. The Taiwanese eternity rule is between these two extremes.
 - 6 What is meant by a “whole-board position” varies. In some rules a whole-board position is any distribution of stones on the board, *together with an indication of whose turn it is*. In other rules, a whole-board position is just any distribution of stones on the board, regardless of whose turn it is.
 - 7 The New Zealand rules allow all suicides. A one-stone suicide is equivalent to a pass. The Taiwanese rules allow all suicides except one-stone suicides (but of course allow passes). The American and French rules forbid suicides.
 - 8 The game is finished, but not because “two consecutive passes automatically end the game”. Indeed, here as elsewhere in this article, *I assume no such rule*. Such a rule would only obscure the issue. The real reason the game is finished lies in the super-*kō* rule: after the two passes, White is still not allowed to capture the marked black stone.
 - 9 I have found this situation in *Ing's SST Laws of Wei-ch'i 1991* by Ing Chang-ki (translated by James Davies, Taipei, Ing Chang-ki Wei-ch'i Educational Foundation, 1991), and in an article by James Davies in *Go World*, 1979, number 12.

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- ¹⁰ The *rules of the New Zealand Go Society* are among the few to which these criticisms do not apply. The NZGS rules cleverly avoid explicit definitions of the formal and practical ends. One of the NZGS rules (call it rule A) is the following: “The game is **finished** when both players agree that there are no more worthwhile moves. Stones may then be removed from the board by mutual agreement.” Another rule (call it rule B) explains how points are counted after the removal of stones by agreement. Rule A does not say that the stones removed are “dead”, or that they “can” or “could” be captured. By simply saying that stones are removed *by agreement*, rule A neatly bypasses the complications described in this article. If at the end no stones are removed, we are at the formal end; if one or more stones are removed, we are at the practical end; but the rules need not mention these two different kinds of end.

Note that rules A and B are *recursive*, that is, they refer to each other: B obviously refers to A, and A refers to B through the word “worthwhile”. They are perfectly valid definitions. They are also concise and elegant. However, such rules might be a source of perplexity to complete beginners, who might not immediately understand the reason for removing stones at the end. Because of this, I prefer rules that define explicitly the formal and practical ends. The *Tromp/Taylor rules of go* posted at <<http://www.cwi.nl/~tromp/go.html>> do this very concisely.

- ¹¹ Translated by James Davies, Tōkyō, Fujitsu, 1992.